

## SHUNT-MODE OPERATION

Op-amps which can operate with the output at one of the supplies can be used in the shunt-mode. Positive shunt-mode operation would involve strapping the output to the negative supply pin, and vice versa for negative operation. To illustrate the concept, Figure 10.14 shows a fully floating 4-20mA industrial control loop transmitter [4]. The idea of shunt-mode operation is to force the supply current of the OP-90 to flow through the sense resistor, R6, thus removing it as an error source. Note that the OP-90 alone cannot directly source 20mA, so an external transistor has been added. The REF-02 provides the 4mA offset and also supplies up to 2mA for transducer excita-

tion. If necessary, R1 can provide an offset trim, and R2 a gain trim. The trims do not interact, because the non-inverting input of the op-amp is at virtual ground. The Schottky diode, D1, is not necessary for circuit operation, but it prevents glitches from pulling the non-inverting input more than 300mV below ground. Without this protection, such glitches could cause phase reversal in the OP-90, possibly causing latch-up of the transmitter. The circuit's linearity is about 0.002%, and its line rejection is 0.002%/V.

Shunt mode operation has also been used to yield output voltages (notably in regulator applications) beyond the voltage rating of the operational amplifier.

### FLOATING 4-TO-20mA TRANSMITTER ILLUSTRATES SHUNT-MODE OPERATION

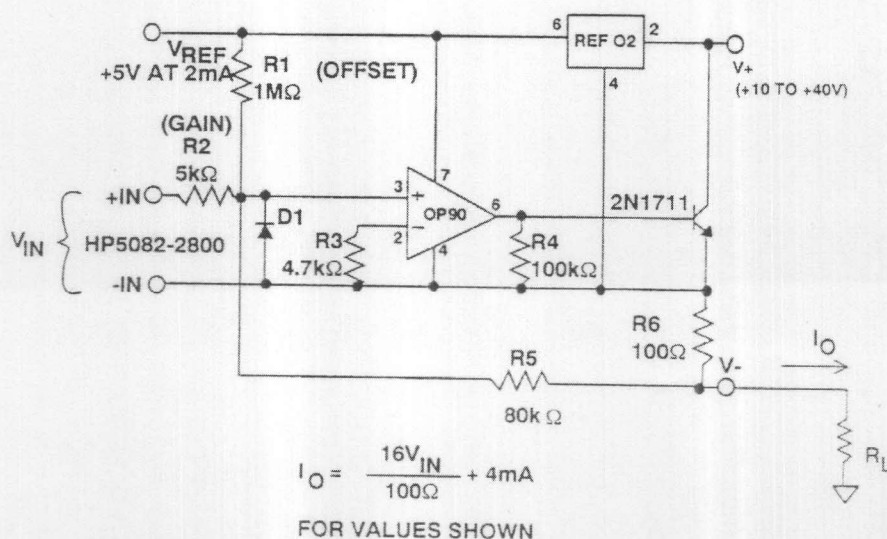


Figure 10.14